A GUIDE FOR AVOIDING
WOOD FLOORING FAILURES
The Professional’s Guide to Avoid Wood Flooring Failures

A wood floor is a beautiful addition to any home or office. But when it shows defects, it mars the floor’s beauty and elegance.

Many of these “defects” are caused by changes in wood moisture.

At Wagner Meters, we’re experts at understanding how moisture can damage wood floors. That expertise is based on 50+ years of designing, manufacturing, and selling wood moisture meters across the globe.

That’s why we created this Guide. We want to help professional wood floor installers, builders, inspectors, and DIYers become aware of the common causes for moisture-damaged floors . . . as well as other areas of concern. Spotting any potential moisture problems, and taking the proper steps to avoid them, therefore, is the key to the most serviceable floor.

How to Use This Guide

There are a couple of ways you can use this Guide.

First, you can go directly to a specific wood flooring moisture topic that best addresses your concern. We’ve arranged the topics in alphabetical order to help in that regard.

Second, you can read through the Guide to learn more about wood flooring moisture issues and concerns in general.

Keep in mind that as you read through the Guide you may find duplicate content. That’s because moisture concerns and solutions in one area may be similar to those in another area.
Prefinished flooring may be less susceptible to moisture absorption, but it too has the capacity to change based on moisture conditions. Acclimation, therefore, is critical when installing wood flooring.

**Acclimation Steps**

Before installation begins, it’s best to place the wood flooring in the room(s) where it will be installed. Always follow the manufacturer’s specific acclimation process. At the beginning of the acclimation period, installers should use a wood moisture meter to measure the MC of the wood flooring and the subfloor to establish a MC baseline.

It’s also an excellent idea to use a thermo-hygrometer to measure the job site’s relative or ambient humidity. Ambient humidity is the moisture content (MC) of wood that is either losing or reabsorbing moisture from its environment.

If the subfloor is concrete and not wood, Wagner Meters also carries the award-winning Rapid RH® for in situ relative humidity (RH) testing. It meets the ASTM F2170 standard – and can do it faster and easier than any other concrete testing device on the market.

The Wagner Orion 950 moisture meter is designed for professional wood flooring installers/inspectors, quality control managers and restoration professionals who need superior accuracy, versatility, data collection, compatibility, and ruggedness in their moisture meter.

The Wagner Orion 950 moisture meter’s dual-depth capability reads at ¼” and ¾” depths to measure moisture in thin wood samples such as floors, or in or thicker wood samples. Its built-in thermo-hygrometer functions measure the ambient temperature and relative humidity, and calculate dew point.

The Wagner Smart Logger™ helps ensure proper acclimation of wood flooring by monitoring and recording ambient RH and temperature 24 hours a day, even when you’re away from the job site. Readings can be downloaded at any time to the Smart Logger app on your mobile device. This way you can be certain you maintain optimal ambient conditions at all times while your wood flooring acclimates.

**Acclimation**

When wood is placed in a kiln, the drying process removes most of the wood’s moisture. This reduction in moisture makes the wood workable for nearly all applications.

But because of the nature of wood, the moisture level of wood doesn’t remain constant. It’s always changing. That means it’s either losing or reabsorbing moisture from its environment.

When the wood is exposed to a “wet” or humid environment, it reabsorbs moisture. When exposed to a “dry” environment, it loses moisture.

This can happen during transportation, manufacturing, storage, or even installation. If the moisture content (MC) of wood is too wet or too dry at the time of installation, it can lead to costly flooring problems later on.

**Why Acclimate Flooring before Installation?**

Since we know wood’s MC will vary – depending on its environment – it’s important to allow each board bundle to acclimate to the job site environment. That means it must be allowed time to adjust to the job site environment before installing, sanding, or staining. If not, unwanted changes may occur to the finished floor.

Consider this – even a change as small as 1/32” per 2” board multiplied across an eight-foot room equals 1 ½” of gapping or swelling.

Engineered wood also needs this acclimation time. It tends to be more dimensionally stable, but it is still susceptible to moisture damage.

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It’s also an excellent idea to use a thermo-hygrometer to measure the job site’s relative or ambient humidity. Ambient humidity is the water vapor in the air surrounding the flooring and has the greatest impact on wood MC.

Knowing the ambient humidity is critical. Because wood is hygroscopic, it moves according to humidity.
When ambient humidity is high, the wood expands. When ambient humidity is low, the wood contracts.

By controlling the humidity, that is, maintaining a stable humidity during the installation process, you can prevent the wood floor from expanding and contracting. A job can fail if you don’t know and keep track of the humidity.

Another important thing to note is the job site’s temperature. Temperature can affect the relative humidity (RH) of air. If lowering or raising the temperature significantly impacts the RH on the job site, reaching equilibrium moisture content (EMC) will take much longer to achieve.

To illustrate, suppose during a winter installation, a very dry cold snap hit your area and drastically lowered the RH. And, at the same time, the heating system wasn’t working properly resulting in a lower temperature than the thermostat reading. The low temperature and low humidity then causes the flooring to significantly shrink, thereby jeopardizing your installation. (NOTE: This example is based on an actual occurrence. Because the installer had monitored the temperature and RH, he was able to discover the problem in time and prevent a very costly disaster.)

A handheld wood moisture meter can be used to take regular readings of the ambient conditions during the installation, but an automated solution ensures proper monitoring and is less time-consuming. Automated data loggers can be installed at the site that will take regular RH and temperature readings and store them for later use.

The Wagner Smart Logger provides constant monitoring and recording of ambient RH and temperature. It can alert you to any dramatic changes at the job site and allow you to take the necessary steps to ensure a successful installation. After allowing time for proper acclimation, the next step in a “proper” installation is to again take moisture measurements in both the flooring and the subfloor. Use a moisture meter to check a selection of boards from each bundle to be sure the wood has reached the correct moisture level (generally 6-8% depending upon your area of the country). For added insurance and peace of mind, use a thermo-hygrometer to ensure the temperature and RH are stable.

So how do you know when the wood has reached the “correct moisture level”? Assuming you have “service conditions” in the environment to which you are acclimating to, you need to calculate the EMC of the environment. EMC is the point at which wood is at the same moisture level as its environment -- meaning it no longer releases or absorbs moisture.

While some manufacturers will recommend a number of days to reach EMC, the only way to be completely confident the flooring has, indeed, reached EMC is to use an accurate wood moisture meter. Doing so gives you a target with which to compare your moisture readings.

The Wagner Orion 950 moisture meter can be used to easily read ambient RH and temperature and calculate EMC. Data can be transmitted via Bluetooth to the free “FloorSmart” app on your mobile device for storage, reporting and more.

There are a number of recommendations for each job site, but always follow the manufacturer’s guidelines for proper acclimation procedures. In addition, the National Wood Flooring Association (NWFA) has specific guidelines you can follow:

- • The space where the flooring will be installed should have adequate ventilation. HVAC systems and any humidifiers that are part of the design should be operational for 5-7 days before delivering the wood flooring. All other materials, like paint, concrete, or plaster, should also be dry before bringing the wood flooring on site.
- • When dealing with a concrete subfloor, it must be dry. The NWFA specifies using RH testing (ASTM F2170) to identify the humidity reading of a slab. Adding a vapor retarder is not required on installations over slabs with a humidity reading of 75% or less.
- • NWFA requires that you test for moisture in the wood subfloor at several locations in the room -- a minimum of 20 tests per 1,000 square feet. Adding a vapor retarder is not required on installations over slabs with a humidity reading of 75% or less.
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TIP: You might also want to use a pinless wood moisture meter to check the walls or wood paneling in the room where the flooring will be installed. You can do this quickly and easily with a pinless meter -- and without damage. The reason for this is that in the event there’s an unseen leak or excess moisture, you can prevent this from damaging the wood floor after installation.

Once installation is complete, test for moisture at several locations in each room where flooring was installed -- a minimum of 40 tests per 1,000 square feet.

Also, be sure to check the temperature and RH against the initial baseline readings.

To Learn More, Visit www.wagnermeters.com
Adhesives

Wood floor adhesives are used to create a bond between the substrate and the flooring, which occurs through a chemical reaction. Although all adhesives work in the same way – changing from a liquid to a solid state – they differ by the carrying agent or catalyst that activates them.

Here are some of the most common types of wood flooring adhesives:

- **Water-based adhesives.** Free of solvents or volatile organic compounds (VOCs) and certified as “very low emissions,” they are favored for health and environmental protection. Their drawback is the limited range of application for certain types of wood flooring or subfloor.

- **Solvent-based adhesives.** Used for several decades, they offer a large range of application and contain solvents which will evaporate during the first weeks after the completed installation.

- **Urethane-based/moisture cure adhesives.** These adhesives offer the largest range of application for certain types of wood flooring and substrates work best with a glue-down method of installation. Engineered wood flooring installed over concrete and plywood commonly use adhesives.

- **Powder adhesives.** These work similarly to water-based adhesives, except you add water and therefore don’t have to worry about freezing or transporting extra weight. The cement contained in the powder will permanently bond most of the water and thus reduces wood swelling compared to water-based adhesives.

Adhesive Use Guidelines

Hardwood Floors, the official magazine of the National Wood Flooring Association (NWFA), offers some guidelines when using wood floor adhesives:

- Don’t spread more adhesive than you can cover in 15 to 20 minutes. If the adhesive is exposed longer, it may start to dry out and not transfer to the flooring surface.

Concrete Subfloors

If you’re going to install wood flooring on a concrete slab, make sure it is clean, dry, and flat. If there’s debris on the slab, the adhesive will form a bond with the debris, not the slab. Therefore, thoroughly vacuum and, if necessary, wet mop the slab to remove all dirt and debris.

Be aware that RH may also affect open time for some adhesives, so always refer to the manufacturer’s guidelines for how much, if any, flash time is required.

When contractors don’t take the time to properly check and prepare the subfloor, this can lead to failed glue-down floors.

In new construction, the slab should be cured at least 60 to 90 days before testing and installation. You should take several readings using in situ RH probes as studies have proven that the old standby, calcium chloride testing, is far from accurate – as you will see below.

Adhesive Failure

Flooring failures cause hundreds of thousands of dollars of damage annually, and the majority of them are related to moisture imbalances that are present somewhere in the environment of the floors.

Concrete subfloors typically have the correct moisture tolerance for the adhesives to reduce or eliminate toxic VOCs. But as a result of these changes, adhesives are now more moisture sensitive than in years past. Therefore, if the adhesive being used to install the flooring does not have the correct moisture tolerance for the concrete subfloor, the entire installation can be at risk.

Most manufacturers provide a maximum moisture value for their product (for warranty purposes) to ensure the concrete slab falls within the appropriate parameters.
required before the flooring is installed. To help ensure that high moisture levels do not end up causing a problem after installation, it is paramount that installers get an accurate reading of the moisture levels in the slab.

Concrete moisture, of course, starts with the original aggregate mix. This moisture dissipates through surface evaporation as the slab dries. As moisture is drawn from the surface, the internal moisture redistributes through the slab, moving more moisture to the surface.

Under ideal conditions, this process happens at a “rule-of-thumb” rate of approximately 30 days of drying time for each inch thickness of concrete in order for the slab to reach a moisture level that is acceptable for some flooring adhesives. As moisture is drawn from the surface, the internal moisture redistributes through the slab, moving moisture to the surface.

Best Moisture Test
As you well know by now, all components of a flooring system are susceptible to moisture – wood flooring, subflooring, and even adhesives. Yet controlling that moisture is a constant challenge for flooring and building professionals.

From subgrade moisture in a slab to each component of the floor system, moisture can cause dimensional changes, adhesive failure, and a host of other problems. In early 2000, Wagner Meters realized this and began looking to address it directly.

Wagner Meters made the decision to partner with the CTLGroup (a subsidiary of Portland Cement Association). Their experience in testing and in troubleshooting in the field proved invaluable in helping Wagner Meters design for real-world situations based on the latest research in concrete moisture.

What their research showed was some significant problems with the accepted moisture test method for concrete at the time – calcium chloride testing. With no scientific basis for the test method, it became clear that many of the moisture-related flooring problems that plagued the industry were connected to a test method that was only able to test surface conditions of a slab, but not accurately determine the internal MC of the slab.

Their research also showed that a different type of moisture testing – one which uses sensors placed inside the concrete slab – proved to supply much more accurate and actionable moisture-testing results. So which test performed the best? The RH test.

Best Solution for Determining RH within Concrete
Unlike surface-based tests, such as the calcium chloride test, RH testing determines the accurate RH within the slab by placing probes at a strategic and proven depth. Moisture often rises through a slab from the bottom to the top in the drying process, so only testing performed at the correct depth can let you determine if the final RH of the slab will be compatible with the flooring and the products used to install it.

Wagner Meters, working with the CTLGroup, developed the Rapid RH concrete moisture test (RH test). The Rapid RH system is based on decades of scientific research and technological advances to help each builder and flooring specialist accurately determine the correct concrete RH level for his or her chosen flooring and products.

The current version of the Rapid RH comes with Wagner’s innovative Total Reader™ and factory-calibrated Smart Sensor design for quick, simple, and reliable results. The Rapid RH line of products is affordable and conforms to ASTM F2170 requirements for easy recording and reporting.

We also understand that sometimes a building project schedule means making alternate choices in adhesives or even flooring products, and the Rapid RH can help you make informed decisions. Along with accurate, actionable testing, we’ve also compiled a one-stop list of manufacturers that provide an RH tolerance for their flooring products at www.rhspec.com.

The truest way to protect a floor system is to be sure that all components are safe from excess moisture intrusion from any source. The Rapid RH helps you be sure that your concrete slab will not be the source of a moisture-related flooring adhesive failure.

Don’t let moisture problems come between you and a successful flooring installation. To Learn More, Visit www.wagnermeters.com
Bamboo Flooring

Bamboo flooring has become quite popular among home and business owners in recent years for a number of good reasons. It holds a beautiful finish, adds a certain elegance and natural feel to any room, and costs up to 50% less per square foot than hardwood. It’s also championed as an eco-friendly alternative to wood.

Yet, as good as bamboo flooring sounds, it poses several challenges – and risks – for professional wood floor installers.

Quality Issues

Not all bamboo flooring sold today is high-quality. There are roughly 1,600 species of bamboo, but only a few are actually good for flooring, such as moso bamboo.

Bamboo is grown in several countries. China is the leading exporter of bamboo, but bamboo is also grown in Vietnam, Indonesia, Japan, and Costa Rica.

Much of the unsuitable bamboo brought into this country comes from China, where there are no governing regulations to control product quality. To generate profits faster, many Chinese companies harvest bamboo before it fully matures and attains its full strength potential. This causes quality to vary widely from company to company.

As a result of bamboo being harvested too soon and glued with toxic adhesives, the bamboo can be easily dented from shoes, furniture, kids, pets, and dropped objects. Once the floor is indented, the finish becomes highly prone to flaking and peeling.

This can lead to costly callbacks for installers. In fact, many customers have complained that their floors were scratched or dented the same day of installation.

Currently, there are no useful quality or grading standards for bamboo flooring. The National Wood Flooring Association (NWFA) has been asked to develop standards, but that task may be nearly impossible because many of the concerns are beyond the NWFA’s control.

For instance, there are many initial steps in the Chinese harvesting and manufacturing processes that are prone to human error and corner-cutting – steps the NWFA cannot control. The only way to establish effective standards for bamboo is to monitor the whole process from beginning to end.

Despite the prevalence of “inferior” bamboo, some bamboo flooring companies like Plyboo, Teragren, and Cali Bamboo take extra steps and precautions to sell what is considered “quality” bamboo.

Types of Bamboo

There are three types of bamboo flooring: solid, strand woven, and engineered. To say which one is best depends on the consumer’s wants.

Solid bamboo flooring has the most natural look possible and provides the richest features and most interesting patterns. When dents or scratches appear, the surface can be sanded down and refinished. The biggest disadvantages: it’s less durable and resilient than strand woven or engineered options.

Strand-woven bamboo flooring tends to be considerably harder and more durable because of the integration of bamboo and the adhesives that hold the strands together. Depending on the thickness of the planks, it can be refinished to remove scratches and dents. The biggest disadvantages: depending on the adhesives used in processing, strand-woven bamboo can emit harmful VOCs and the processing removes some of the natural bamboo features, giving it a less natural look.

Engineered bamboo flooring may look like it’s made of solid pieces of bamboo, but there is actually very little natural bamboo in each piece. A wear layer is installed over the top of the tile or plank to protect the bamboo veneer, while the bottom of the tile also gets a waterproof layer of protection. Sandwiching the actual bamboo between those two surfaces makes it nearly impervious to moisture and stains. It’s also extremely strong, durable, and easy to maintain. The biggest drawback is that an engineered bamboo floor cannot be refinished. Although the wear layer is quite durable, it will degrade over time and the floor will have to be replaced.

Moisture Precautions

Drying bamboo at the factory is difficult because it’s hard to measure the moisture.

Most Chinese factories don’t dry the bamboo down to a target moisture level as we do with wood in the U.S. Instead, they depend on a fixed schedule.

Even when bamboo is carefully dried, consistent MC appears to be a problem for all strand bamboo manufacturers. It can cause bamboo to expand along its length and width.

With strand-woven bamboo’s extreme density and fibers sheathed in glue, acclimating it at the job site can take a long time – sometimes several days or even weeks, depending on the local climate. In fact, strand-woven bamboo can take much longer than other flooring to acclimate.

TIP: Installers should use the same caution with bamboo as they do in treating hardwood. It’s also extremely strong, durable, and easy to maintain. The biggest drawback is that an engineered bamboo floor cannot be refinished. Although the wear layer is quite durable, it will degrade over time and the floor will have to be replaced.

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Moisture Precautions

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"Cupping claims on installations over concrete are a huge problem." Harrington says that many claims for strand-woven bamboo are puzzling. Claims inspectors and glue manufacturers report finding concrete slabs within allowable limits and vapor retarders properly applied, yet the floor still cupped.

The problem, writes Harrington, is that when strand-woven bamboo is installed on a slab, the density and the resin make it hard for the vapor to escape. This causes moisture to slowly accumulate and condense on the slab’s surface. As a result, the bamboo itself becomes a vapor barrier, but one that over time slowly absorbs water. This condensation of water under the strand bamboo may also account for the relatively large number of so-called “glue failures” that are seen in these installations.

The solution to this problem with strand-woven bamboo calls for installers to thoroughly test and seal the concrete, and to avoid installations where there is any sign of a moisture problem.

When working with traditional bamboo, Harrington says that pin meters work fine. He advises always inserting the pins parallel to the grain and to exactly the same depth. This, he notes, helps make certain you avoid crossing a glue line, which can distort the reading.

For strand-woven bamboo, Harrington says that in his experience, it’s best to use a pinless meter.

Mold Problems
Before installing traditional bamboo floors, installers should look for grayish, streaky discoloration in the planks. It’s likely a fungus attacked the bamboo during the first few days after harvest.

Raw bamboo rots quickly, so it’s normally treated within two days of being cut. If the treatment is too late, the mold may still be visible in the finished floor even though it was killed. There are cases where the mold was still alive and spread in the floor after installation, even in a dry environment.

If mold is suspected in a traditional bamboo plank, installers would be wise to avoid using it. Mold is not likely in strand-woven bamboo because the glue and curing process should kill any spores.

Installation
Acclimation. Before any flooring product is installed, it needs to reach EMC with the job site environment. This is especially critical with bamboo.

Unlike most floors, bamboo expands along its length and width. Strand-woven bamboo, in particular, can take significantly longer than wood flooring to acclimate.

The room must be at service conditions and sufficient time must be allowed to let the floorboards reach EMC before installation begins.

Securing bamboo to the subfloor requires special care. Nails or staples can easily damage the bamboo. Care also must be taken to keep the surface clean for glue-down installations. Glue that gets on the surface of the floor can be carefully removed, but it’s difficult -- just like it would be for a standard hardwood floor installation.

It’s been recommended that bamboo floors not be installed in regions with high humidity due to the unpredictable rate of expansion and contraction during seasonal changes. If bamboo is installed in these high humidity areas, installers must ensure proper acclimation is allowed.

After installation, property owners in high humidity areas should carefully monitor room conditions (temperature and RH) to prevent potential problems.

Health Concerns
To create flooring strips, the bamboo must be glued together and compressed under extreme pressure. Some manufacturers use urea and formaldehyde in the gluing process, which is known to cause serious health problems in some humans.

One installation risk is formaldehyde off-gassing. Installers who need to cut or sand bamboo flooring should wear a mask and clothing that protects the skin. Because formaldehyde is also a pungent-smelling gas, the stench alone can be unbearable.

Customers, too, can become ill from off-gassing -- even long after installation.

Some manufacturers, however, are “Green” certified. Consumer Reports in their August 2009 edition rated EcoTimber’s strand-woven bamboo as #1 and Teragren’s Synergy bamboo #2 in the U.S. Both companies make products to the highest standards with either very little or zero formaldehyde. The less formaldehyde that off-gasses, the safer the flooring is for the installer and the customer.

Despite some drawbacks and risks, however, bamboo flooring can still make a great floor. The key to satisfaction: It should be properly made and installed by a reputable company with several years of experience importing and installing bamboo. And thorough moisture testing should be part of the installation process. *

To Learn More, Visit www.wagnermeters.com
In recent years, engineered flooring has surged in popularity, both in homes and commercial applications, for several reasons. It comes in a wide variety of colors, textures, and strip widths to suit most any taste, it is durable and cheaper substitute for solid wood floors, and it is more versatile and eco-friendly.

Because engineered flooring is less prone to moisture damage, it can be installed in basements, kitchens, and bathrooms. These are places where moisture and higher levels of humidity are often present.

NOTE: Although an engineered floor can, in many situations, be a better choice than a solid wood floor, it is not perfect. For instance, complications may occur after installation due to undesirable moisture and RH levels in both the engineered product and the concrete or wood subfloor. In addition, despite the fact that engineered flooring can be installed in places unsuitable for solid wood, it is not meant for extreme conditions. Installers should be aware that large humidity swings, excess moisture, and lack of climate control can cause engineered floors to break down just like wood floors.

RH Concerns

The space for the engineered flooring needs to be conditioned based on the manufacturer’s guidelines. Manufacturers typically require a range between 35% and 55% ambient RH, but those guidelines can vary. Some manufacturers may have a range of 40-60% RH, while others may require 30-50% RH. National Wood Flooring Association (NWFA) guidelines state 30-50% RH as a general rule of thumb.

It’s important for installers to know if the end-user has the ability to control the climate within those ranges after installation. Otherwise, trouble can occur. For instance, if an engineered flooring manufacturer’s low RH range is 40% and the product is installed in Nevada where the average RH is about 30%, problems can occur – unless the end-user is able to control the RH.

The same issue can occur in the Midwest where the humidity varies widely between winter and summer. When it’s 5°F outside, it’s difficult to maintain the RH at 40% when the furnace is running constantly. Such imbalances can lead to face-checking/splitting, delamination, and end-gapping. In these cases, flooring failures may not be covered under warranty.

When indoor RH is low, “dry cupping” can occur in engineered flooring. The top wear layer tends to dry out much faster than the core board material, especially if the wear layer is thin. As the wear layer rapidly dries, it tends to pull away from the bottom core material. The result is a cupped floor, with the corners lifting or curling first.

In addition, splits and checks can also occur when RH is low. Splits are openings that run from top to bottom, while checks are smaller openings that don’t run as deep. The stress in the boards can also cause the finish to show wrinkles or ruptures.

To prevent complications because of low RH, it’s recommended that the end-user install a whole-house humidification system that turns on with the heat. Whole-house humidification systems not dependent on heat also are available for arid climates such as in the Southwest. At minimum, small portable humidifiers can also be used. The key is to keep the RH levels constant, even if a bit high or low, to prevent cracking and checking in the boards.

Wood Moisture Concerns

Although engineered wood flooring is less prone to moisture damage, it is wood after all and still requires the same MC management as any other wood product. All wood holds MC. As the RH rises, wood...
absorbs moisture from the air. And, as RH falls, wood releases moisture into the air. Wood, therefore, must be allowed to reach its EMC. That is, it must reach a balance between the wood's MC and that of the ambient conditions.

Also, some engineered products combine several kinds of wood, each with its own distinct MC characteristics. If installers don’t pay sufficient attention to those wood characteristics, problems may follow.

Another important factor about engineered flooring is that the core and the wear layer react differently to moisture. If the two have different MC levels, the damage that results is not much different from what can happen when a hardwood floor and its wood subfloor have different MC levels. Performance of the floor in these conditions depends on several factors, including MC at the time of manufacture, core construction types, and thickness of the wear layer.

If the top wear layer and the core have the same shrinking tendencies, engineered wood will move just like solid wood. If the top layer and the core shrink differently, then the panel is more moisture sensitive. This can cause more shrinking and warping.

As a general rule, the core of engineered flooring is more dimensionally stable than solid wood flooring because of its multiple layers of plywood, high-density fiberboard, or hardwood. However, large humidity swings, excess moisture, and lack of climate control will cause an engineered floor to fail just like a solid wood floor.

Experts in the wood flooring industry recommend measuring for MC and RH before and during installation. Relying on old-fashioned methods of feeling the wood or eyeballing the subfloor can be risky, resulting in costly problems later.

A good wood moisture meter is essential for any successful wood floor installation. Installers can easily use hand-held moisture meters to accurately and cost-effectively assess the MC of their wood.

It’s important for installers to document the moisture measurement readings at the time of delivery, before acclimation, and after the job is completed. Then a copy should be given to the homeowner in case a warranty issue occurs later. Waiting until the floor shows defects from shrinking and cupping may be too late to file a claim if the MC at the time of delivery cannot be determined or verified.

Concretemoisture and RH Concerns

Although engineered flooring can be installed successfully on either on-grade or above-ground concrete slabs, it’s critical to understand that moisture measurement and management are necessary for the concrete slab as well as the hardwood flooring. Like wood, concrete has independent, changeable moisture levels that vary with changes in ambient RH.

Concrete absorbs water vapor as RH rises and releases water vapor into the air as RH falls. Moisture can also enter concrete from other sources, such as excessive rainfall, ground seepage, or a leaking appliance. This will upset the balance between ambient conditions and the conditions necessary to have engineered floors look and function properly. The reverse is also true. Installers, therefore, must be certain MC levels are stable in both concrete and wood before combining them.

According to flooring industry standards, concrete subfloors should be given enough time to dry to an appropriate RH level before engineered flooring is installed. In this instance, installers should use a wood moisture meter to ensure precise moisture measurement of the finished wood flooring product and an appropriate RH testing device to ensure concrete feasibility for installation.

Certainly, engineered flooring provides customers and installers with a number of options for an aesthetically-pleasing, long-lasting installation. However, it’s important to know the conditions where the flooring will be installed and the acceptable RH range from the manufacturer. While engineered flooring may be less susceptible to moisture, the flooring material and the concrete slab should still be checked for moisture to avoid costly callbacks and unhappy customers.

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Finishes

When installing wood floors, builders, installers, and DIYers need to consider that wood finishes also contain moisture. Therefore, installing wood floors with healthy and durable finishes means understanding the moisture interactions between both the floor and the finish.

Types of Wood Finishes
Wood floors installed prior to the mid-1960s were likely finished with varnish or shellac. It’s fairly simple to check if that’s the case.

Find an inconspicuous place on the floor and scratch the surface with a coin or other sharp object. If the finish flakes, it is probably shellac or varnish: floor finishes of a bygone era.

Here are the different types of wood floor finishes currently available:

- **Oil-modified urethane** is generally the most common surface finish and is easy to apply. It has a petroleum base with a blend of synthetic resins, plasticizers, and other film forming ingredients that produce a durable, moisture-resistant surface. These finishes are clear and non-yellowing, and come in different sheen levels. They have a milder odor than oil-modified finishes and dry in about two to three hours. Water-based urethanes are generally more expensive.

- **Conversion-varnish sealers (Swedish finishes)** are two-component acid-curing, alcohol-based sealers. Because of their country of origin, conversion varnish sealers are often referred to as Swedish finishes.

- **Penetrating sealers** are solvent based. They’re spread on the floor and allowed to penetrate. The excess sealer is removed with rags or buffed in with synthetic or steel wool pads. This type of finish often has a color and can be used to stain and seal the wood floor. Penetrating oil sealers, made from tung or linseed oil, contain additives to improve drying and hardness.

- **Wax** is the oldest and, in some ways, the best. Wax is the easiest to apply, least expensive, fastest drying, and easiest to repair. With proper care, it will survive indefinitely. Wax over a penetrating stain and the system is in the wood so you wear the wood, not the finish. Wax is spread in thin coats for surface protection after the stain and/or sealer is applied, then buffed to the desired sheen.

- **Shellac** – This product (natural shellac) contains wax and is not widely used for top coatings in today’s wood flooring market. De-waxed shellac is being used more and more as a wood floor sealer.

What to Remember
Any wood flooring finish involves moisture. With the exception of the wax finish, all other finishes contain some form of liquid material. In addition, all wood has a certain level of MC or water vapor within every single wood cell. Installers must remember that water, oil, synthetics, and stains all interact with each other when installing wood floors with any finish.

Wood stain must dry completely before applying wood finishes in order to avoid finish failures. For the best results, keep room temperatures between 60 and 80 degrees, with RH between 30 and 50 percent. Outside these parameters, wood finishes may not dry properly, thus opening the door to finish failures.

TIP: Check the manufacturer’s ambient RH specifications before applying wood finishes.

Another potential problem: Over their lifetime, some wood floors may have been refinished a number of times. Many initial finishes are likely to have contained VOCs. Since wood finish manufacturers have begun to replace VOCs with water-based formulas, the interaction of VOCs from a previous finish with the new water-based finishes can lead to finish problems as well.

Also, keep in mind that either type of finish (those containing VOCs or water-based formulas) can still produce floor finish problems related to improper moisture MC in or beneath the flooring.

Floor Finish Problems & Causes
Some common challenges with wood floor finishes might include:

- **Peeling, bubbling, and blisters** can occur for a number of reasons. The wood finish may have been excessively burnished, the finish was not allowed sufficient time to dry; the product may be incompatible; the finish perhaps was insufficiently wiped leaving a heavy pigment on the surface; or, the surface may have been contaminated during maintenance by wax or oil-based soap. In any of these situations, an adhesion problem occurs between the flooring and the finish.

- **Roughness** can result from an exposure to moisture, such as a spill or a constant moisture source (e.g., plumbing leak), which causes the wood surface grain to rise from the condensation. Poor sanding, edging, and scraping can also lead to a rough finish. Finish contamination (like sawdust or lint) during the drying phase can also mar a smooth finish.

Excessive and early wear on finish can happen when improper care and maintenance occurs on the wood flooring and when dirt and grit are allowed to penetrate the wood flooring surface over an extended period of time. Exposure to excessive moisture, strong soaps, chemicals, dragging heavy furniture across the floor, and furniture legs without pads beneath them can also cause early wear on finishes.

Stains and discoloration are the result of a variety of causes. They include moisture damage from spills, moisture from a continual source that leads to mildew and decay, adhesives that “bleed” into the wood, pet problems (urine), improper maintenance with water or harsh chemicals, traffic wear patterns, oil soap residue, or even fading from exposure to direct sunlight.

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Installation

When working to prevent moisture-related problems with wood flooring, there are multiple layers that can contribute to moisture issues. Simply acclimating and installing the flooring product itself is only one step in a series that should be included when installing wood flooring products.

The Concrete Slab

“I’m a wood flooring specialist; why would I need to know about concrete?”

For a wood floor installed over a concrete slab (whether that includes a separate subfloor or not), the moisture picture in the concrete slab can have real ramifications for the finished floor. If a new slab has not dried completely to finished specifications, that moisture will continue to wick up through the surface of the concrete and can cause such things as adhesive failure, wood warping, or cupping.

Concrete moisture conditions are most reliably established with RH testing that uses in situ probes. Other test methods, including calcium chloride testing or the poly-film test, have proven problematic in the past and are slowly being discontinued by organizations like the Maple Flooring Manufacturer’s Association.

Other varieties of meters, like surface concrete meters, might at times be helpful in determining the most likely areas for additional testing. But once these meters find areas for further testing, true quantitative moisture testing methods such as in situ RH testing as outlined in ASTM F2170 should be used.

NOTE: Surface concrete meters do not provide an in-depth picture of moisture conditions within the slab, therefore, true quantitative testing must be done.

While you, as the flooring contractor, may probably not perform the RH testing, it pays to check what the job specs have called for, and what the test results have shown before beginning your installation. Moisture problems in the concrete slab may not ultimately be your responsibility, but left unchecked they can, unfortunately, often end up becoming your problem.

The Wood Subfloor

Improper moisture conditions in a wooden subfloor can lead to moisture-related issues in a finished floor. Two types of moisture meters are often used to determine the MC of wood subfloors: the pin-style meter and the pinless (or non-destructive) meter.

A pin-style meter measures the MC of wood by running an electrical signal between the tips of two sharp probes that are inserted into the wood. They can indicate moisture levels through either analog or digital displays, and can also include a range of pre-programmed settings for different wood species, or a table for manually adjusting the readings to the required species of wood.
One advantage of pin-style meters (only those that use longer pins with insulated shafts) is that you can test at different depths in the wood. The major disadvantage is the relatively small area tested with each insertion.

Pinless meters use an electromagnetic signal to penetrate the wood surface and measure the MC of the wood being checked. Their design lets users “scan” many board feet of wood product simply and quickly.

Pinless meters, like their pin-style counterparts, can be user-programmed for various species of wood.

With either style of wood moisture meter, it is important to test several areas of a wood subfloor and finished floor to be sure that the moisture conditions are acceptable for the final flooring installation.

Below are National Wood Flooring Association (NWFA) guidelines for subfloor and finished floor moisture testing:

**Wood Subfloor Requirements**
- 20 tests per 1000 sq. ft.

**Finished Floor Requirements**
- 40 tests per 1000 sq. ft.

The NWFA also states that when installing on a wood subfloor and the finished floor is less than 3 inches wide, there can be no more than a 4% MC variance between the subfloor and the finished floor.

The Flooring

Before installation, the flooring to be installed should also be checked with an accurate wood moisture meter. Several bundles should be opened and tested to ensure that the wood flooring is at the same MC throughout, and is compatible with the subfloor over which it will be installed.

Like the wood subfloor, pin-style and pinless meters can give an indication of the MC to ensure a professional and long-lasting flooring installation. One major advantage pinless meters have over pin meters is that they cause no damage to wood flooring. No pin holes means no filling or sanding on the final floor.

Of course, room conditions should also be monitored to ensure temperature and RH are at acceptable levels. Even a good flooring installation with adequate moisture testing might not overcome extreme changes in ambient temperature and humidity.

Allowing the wood products to acclimate to these normal ambient conditions is one of the best-recommended practices.

**Wood Flooring over Radiant Heating**

With the increased use of hardwood floors over radiant heating, installers need to make certain they’re installing wood flooring over a dry slab and a dry subfloor. The best way to dry a slab and subfloor system is to turn on the radiant heating system before installing the wood flooring.

If this isn’t done, moisture left in the slab will enter the wood flooring as soon as the heat is turned on. The result: floors can expand, contract, shrink, crack, cup, and bow excessively.

How long should the heating system be turned on? Opinions vary. Some say at least 72 hours before installation, with a preferred time of five to six days. That assumes that the slab has been in place for at least 60 days.

If the slab is relatively new, it’s recommended to have the heating system turned on for 30 to 60 days before installing wood floors. Of course, follow the recommendations of the wood flooring manufacturer for the preferred time.

Radiant heat will dry the wood to a lower MC toward the end of the heating season. When the heat is turned off, the moisture once again starts to seep in.

To avoid this, owners should be advised to gradually turn on the heat before the first really cool day. This will begin the seasonal movement more gradually. As always, humidity controls can help offset flooring expansion and contraction.

**NOTE:** Not all wood species are good candidates for installation over radiant heating. Follow the manufacturer’s recommendation for species’ suitability over radiant heating.

To Learn More, Visit www.wagnermeters.com
Here are some basic dos and don’ts of hardwood floor maintenance:

Protect the Surface

- Place mats at all entry doors.
- Wipe shoes on the mats before stepping onto the hardwood floor. This will help remove rocks, debris, and anything else that can scratch or mar the hardwood floor surface.
- Homeowners should regularly trim their pets' nails to avoid scratching the floor.
- Place protective pads beneath the furniture legs. This helps distribute the weight and prevents or greatly minimizes denting and scratching.
- Avoid sliding heavy furniture on top of the floor.

Clean the Surface

- Never use petroleum-based cleaners on water-based finishes.
- Never use wax on top of a non-wax surface finish.
- Never use a water-based cleaner on waxed floors.
- Always use the manufacturer’s recommended cleaning products.
- Avoid any cleaning product not recommended by the flooring manufacturer. Many of these products contain ammonia, while others contain oil soaps. Both are very harmful to hardwood floors after medium and long-term use.
- When a manufacturer’s recommended cleaning products are not readily available, some hardwood flooring companies suggest using water and vinegar as an acceptable and inexpensive alternative. Mix half a cup of plain vinegar (not apple cider vinegar, etc.) in a gallon of warm water, then apply a very small amount to a sponge mop with a spring type wringer. Do not use excessive amounts of vinegar. Vinegar is an acid base “solution,” but it works fine to cut grease. Do not use a “swab the deck” type cotton mop because it puts too much water on the floor.
- Do not use excessive water or wet mopping. Excess water will damage the floor by causing the wood panels to expand. Instead, use a damp sweeper to clean.

Avoid Moisture Problems

- Wipe off any liquid spills as quickly as possible.
- Use rugs beneath a kitchen or powder room sink when hardwood flooring is installed in these areas. This will help minimize or avoid potential water damage.
- Depending on your geographical location, it may be appropriate to install a humidifier, or dehumidifier, to keep the MC constant all year long to avoid excessive shrinkage or expansion of the wood floor.
- Routinely check the floor for signs of moisture intrusion – preferably with a wood moisture meter. A moisture meter can help spot problem areas before they become an irreversible problem.
- Be aware – some seasonal changes like small gaps in the wood floor are normal, but any prolonged contact with external moisture can greatly impact the floor’s performance. For instance, leaking plumbing or appliances, ground water intrusion, or severe and prolonged shifts in humidity can all take their toll on a wood floor.
Mixing Hardwood Floors

In purely cosmetic considerations, mixing wood species and grains can result in beautiful patterns, colors, and textures for dynamic results. However, whether in assembly or in installation, it is critical to keep this thought in mind: each type or species of wood has its own specific gravity.

Consider: If flooring manufactured with one wood species naturally shrinks or expands at one rate, the same floor manufactured with mixed wood species can shrink and expand differently according to each wood species shrinkage value. Also, measuring engineered wood flooring manufactured with different wood species and wood composites makes moisture measurement even trickier.

Mixed Wood Moisture Measurement

It is important that the wood moisture meter has measurements within a MC range of the specific type of wood an installer is working with. The meter should be programmable for the species of each wood type in order to successfully measure the MC.

When installing wood floors or restoring old ones, installers should use a moisture meter to discover when it is safe to add another coat of finish to finely-sanded wood flooring.

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WAGNER METERS offers a variety of moisture meters for wood for every situation. The Wagner Orion® 950 Smart Pinless Wood Moisture Meter reads MC between 4-32%. This is a very useful meter to help with installing wood floors with common hardwoods, softwoods, and exotic species.
Moisture and Wood Background

Wood is a hygroscopic material, meaning it easily absorbs moisture. Wood cells fit together like groups of drinking straws or thin pipes. The cell wall naturally contains a small amount of moisture, and the “hollow” part of the cell also has room to hold and release moisture. While a tree is growing, this cell interior conducts water and nutrients from the top of the tree. Anyone working with wood should know this fact: wood and its environment continually interact — even after a tree is cut down and milled.

Once a tree has been cut, the “green” lumber is kiln-dried to remove the bulk of that mobile moisture before the lumber is manufactured into various wood products. The structure of the cell, however, remains the same. That enables it to reabsorb moisture from its environment or release it into the air.

Homeowners (and even some installation professionals), however, at times mistakenly assume that the wood flooring’s MC has been resolved once and for all after the kiln drying manufacturing process. That’s not the case.

As pointed out, the wood constantly reacts to the environment in which it is placed. Such things as high RH, a leaking pipe, moisture wicking up from the concrete subfloor, exposure to liquid spills, finishes, and adhesives — all can alter the MC of wood.

NOTE: Should wood flooring be exposed to excessive moisture or to very dry conditions, the dimensions of the wood will expand or contract accordingly. When the rate of expansion or contraction changes too drastically, wood flooring will show some tell-tale and potentially problematic signs.

5 VISIBLE MOISTURE PROBLEMS

Cupping

Cupping is caused by a moisture imbalance through the thickness of the wood and shows up as a curve from side to side. In other words, one side is higher than the other side, or both sides are higher than the center.

Causes may be a water source from below the flooring, or from ambient RH changes in the surrounding environment. Cupping most often appears after the floor has been installed. It may or may not be an installation issue.

TIP: Before sanding, give the floor time to dry and return to a balanced state.

Abnormal Gaps between Boards

Some slight spaces between boards are common and are only a seasonal variation as ambient RH changes. For instance, when homes are heated in the winter, RH levels can plummet. This causes boards to shrink and spaces to appear between the boards as the wood loses moisture. If this is a problem or concern, homeowners can install a humidifier in the furnace to add moisture to the air to prevent gaps from occurring.

In summer, when humidity rises, gaps between boards normally close as the wood absorbs moisture.

NOTE: If the flooring was installed while the MC was still higher than the surrounding air, the spaces between the boards will grow larger as the boards dry. The wider the board, the wider the gap will become.

Large gaps can also be caused by environmental issues such as “hot spots” created by appliances or inadequately insulated heating/cooling ducts that increase the rate of moisture movement in select spots of the floor.

Buckling

Buckling is the most extreme reaction to moisture in a hardwood floor. When buckling occurs, the wood flooring actually pulls up from the subfloor. In some cases, it can lift several inches in one or more places.

Fortunately, this is not a common occurrence. Buckling usually happens after a floor has been flooded for a period of time. Incorrect installation may contribute, too. In either case, buckling is extreme enough to generally require correction for the moisture problem and then reinstallation.

If caught early, spot repair and replacement may be possible. Once the standing water is removed, several boards can be taken up from the floor so that the air can circulate across and below the floor. Once the floor has dried to a more stable moisture level, repairs can usually be made.

Squeaking

When a wood floor has been subjected to repeated significant moisture changes, it can result in popped nails, subfloor problems, or adhesive breakdown. When this occurs, the flooring has room to move or rub against the different parts of the floor system. These squeaks, groans, and other noises may be indicative of ongoing moisture-related problems.

Wood Subfloors

Determining MC is an essential part of quality control within the flooring installation process. Flooring installers must know the MC of the subfloor as well as the wood flooring. Test for moisture at several locations in the room — a minimum of 20 per 1,000 square feet — and average the results. Make sure to measure all exterior and plumbing walls. In most regions, a dry subfloor that is ready to work has a MC of 12% or less. If you record high MC readings, do not proceed with the installation until the origin of the
Moisture is identified and all moisture-related problems are remedied.

Concrete Subfloors
All types of flooring are susceptible to failure if moisture conditions are not properly monitored and maintained. When the subfloor is concrete, a moisture problem may begin long before the flooring is installed. If the slab has not been properly dried, moisture problems are almost guaranteed with wood flooring applications.

Accurate moisture testing is critical for any concrete slab. ASTM International has provided several standards for testing moisture with two different test methods before installing flooring over a concrete slab: in situ probes per ASTM F2170 and calcium chloride testing per ASTM F1869.

The best indicator of moisture is RH testing using in situ probes per ASTM F2170. Their depth-specific application has proven to provide an accurate representation of moisture conditions within the concrete slab. Their very location within the concrete means they are less susceptible to environmental or ambient changes at the surface.

The calcium chloride test, on the other hand, has proven to be unreliable in their results because they are only measuring moisture passage from the concrete at a very shallow depth. Consequently, this test shows the slab's surface to be drier and less acceptable as a reliable test method.

The plastic sheet test has also proven unreliable. This test involves taping a square of clear plastic on the surface of the slab, then returning 16 hours later to see if there’s moisture under the plastic. Temperature and dew point can affect this test, and a dry sheet isn’t necessarily a sure sign that the slab is dry enough beneath the surface.

Some people may use hand-held concrete moisture meters, but they work well only as a general survey tool to find locations for further testing. They do not read far enough into the slab for a true overall moisture picture. Their electromagnetic field only penetrates about one inch or less into the slab and can give very misleading information regarding the overall moisture conditions.

Leaks or Water Intrusion
Any moisture that comes from below a subfloor or gets between the subfloor and the flooring can cause problems over time. Leaking appliances, ground water intrusion through a perforated vapor barrier, condensation, and even moisture from a concrete subfloor that wasn’t completely dried can introduce moisture to your flooring equation.

Also, don’t overlook the outdoors. Water from a sprinkler system that saturates the concrete foundation or rain water that is not properly diverted from the foundation can cause moisture-related problems with the wood flooring over time. Once the concrete foundation absorbs sufficient moisture, it can wick up into the wood flooring.

**When Wood Is Too Wet**
First, let’s look at some of the challenges if wood is too “wet” or has a high MC.

Shrinkage
Wood that has a high MC will begin to shrink in all dimensions as it begins to lose that excess moisture. Most impacted, though, is width and thickness. If you fit wooden floor boards together that have excess moisture, that change in dimension can lead to cupping, gaps, or buckling. Not a pretty sight and, in extreme cases, a safety hazard too.

**When Wood Is Too Dry**

Swelling
Just as drying wood shrinks, wood that is absorbing moisture from its environment can lead to cupping, gaps, or buckling. Not a pretty sight and, in extreme cases, a safety hazard too.

Brittleness
Overly dry wood can be more brittle, meaning nailing, sawing, or other aspects of installing can lead to splits, cracks, knot loss, and other damage, particularly if working across the grain.

Tool Wear
Trying to put “wet” lumber through many machines can cause both damage to the tools and danger to you. Wet sawdust or shavings catch on blades and other moving parts and can effectively “gum up” the tool works inside a machine, and shorten their lifespan. High MC wood is also more prone to catching or kickback.

Wood Damage
Chisels, saw blades, drill bits, and other tools can also dull faster if wood is not at the correct MC for its species and the geographic area it’s installed in.

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**Knowing When Wood Is Too Wet or Too Dry**
If a living tree has just been cut, it’s wet. That’s a guarantee. After that, though, any rule of thumb will be no more than an estimate.

While there are many guides or tables available to help identify the correct MC for a geographic region, ultimately MC is best monitored with an accurate wood moisture meter. Even within one geographic region, temperatures and ambient humidity can vary. In interior installations, the operation of the HVAC system will play into wood’s MC level.

The target, really, is to identify the point when the wood has reached a balance with its environment, a state referred to as EMC.

**The True Target: EMC**
Think of EMC as MC in context. The natural give and take of wood with the moisture of ambient humidity will eventually come to a resting state, and that will be the best time to move ahead with the wood flooring installation.

And knowing that your wood has reached its EMC will give you the confidence to move ahead with less risk of a project damaged by a MC level that is too high or too low for conditions.

**Minimize Problems with Moisture Measurement**
The best step for protecting a wood floor from these moisture-related problems is to measure both the subfloor and the finished wood flooring’s MC thoroughly and accurately before and during installation. It’s also critical to determine MC when repairs or remediation are needed.

**NOTE:** Using a wood moisture meter is absolutely necessary to measure the MC of wood flooring at any stage – from when the flooring arrives at the job site, through installation, and even sanding and finishing when refurbishing is needed.

**TIP:** We recommend using pinless moisture meters for wood flooring. Pinless meters can quickly and easily measure the MC below the wood surface without doing any damage to the wood flooring. The use of pin meters is likely to leave unsightly holes in the wood.

Our wood moisture meters are able to measure hardwoods, softwoods, and exotic wood species. We also have additional instruments for testing concrete slab subfloors.

To Learn More, visit www.wagnermeters.com

At Wagner Meters, we sell highly accurate and reliable pinless meters. But don’t just take our word for it. Testing by universities and other third-party organizations prove that Wagner meters are more accurate and reliable than any other brand on the market.

Here are four tests that support our claim of exceptional accuracy and reliability:

Visit the following links to see the accuracy of Wagner moisture meters compared to three resistance-type pin meters for measuring wood MC.

http://ow.ly/gsXJ306ALI0
http://ow.ly/CZEN306AKvD
http://ow.ly/fo5A306AJRK
OR scan the QR code.

This test provides comparative testing of Wagner meters and the oven-dry method. It’s also a must to remember that after a measurement, the wood may need to be rechecked, and gouging are more likely in effect, softened with the additional moisture, tools are more likely to tear or rip the wood instead of cut it. Tear-out, checking, and gouging are more likely on high MC lumber. Even sanding can tear up the surface, rather than smooth it, when the wood’s MC level is high. It’s also a must to remember that after the wood dries, the chances of cupping, raised grain, checking, or dimensional changes mean the wood may need to be worked again.

Adhesive Problems
Unless you use glue or adhesive specific to wet situations, high wood MC can mean glue joints do not hold properly over time. If the wood dries after it has been glued, that inevitable shrinkage will put joints at risk as one piece of wood tries to pull away from another piece of wood. For glued-down flooring, where use adds stress to the joints, this can be disastrous. Moisture can also slow glue curing times.

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Sanding

Unless a floor’s surface has been damaged, most modern floor finishes will not require sanding for 10 or even 20 years.

If sanding is needed, safety is a major consideration. Here are some key safety issues to consider in the sanding process:

- **Fire concerns.** Sanding dust can ignite spontaneously in any of several ways.
  - The least common is the wood dust starting on fire in the dust collection bag when a new floor is being sanded. It can happen when the heat created from the friction of the machine and sandpaper on the floor increase to the point that the sawdust begins to smolder inside the bag.
  - A more common occurrence of ignition occurs when an old floor is being sanded. The old finishes on the floor that are ground into a fine powder can be ignited by heat from friction.
  - Yet another cause of fire, though not spontaneous combustion, is when small sparks fly into the dust-collection bag. These sparks are often caused by abrasives striking nails. For that reason, all nails should be set before sanding. This also prevents damage to the machine.

- **Proper electrical connections.** Refer to local electrical codes and to manufacturer’s guidelines for each piece of equipment.

- **Read the sanding manufacturer’s warnings and operational instructions.**

- **Walk the floor and make necessary repairs before sanding.** This involves sweeping and inspecting the floor carefully. Properly fasten or adhere the floor to the substrate before sanding begins. And, as noted above, countersink any protruding nails.

- **Use eye, ear, and respiratory protection devices as required by OSHA.**

- **Use safe work shoes** with laces tied.

- **Make sure you are always in complete control of all equipment.**

- **Keep electrical cords away from machines’ moving parts.** Also keep cords out from underfoot and off your shoulders.

- **Unplug all machines when you are repairing or adjusting them, or when changing abrasives.**

- **Don’t smoke on the job.** Smoking can also lead to ignition if cigarette sparks land on the sanding dust. And when removing sanding dust, don’t toss a burning cigarette into the dust.

- **Control the dust.** Seal off the area, including doorways, with plastic. If possible, use a fan to exhaust dust from the working area. On some jobs, it might be good to protect the wall coverings and ceilings. If light fixtures are covered, remove the bulbs to prevent a fire hazard should someone turn them on.

- **Shut off the HVAC system.** Do this while sanding. If it’s necessary to run the HVAC system, use prefilter materials to cover HVAC returns. Check with a local HVAC contractor to determine which prefilters are appropriate.

**Moisture Concerns**

Before sanding, either a new wood floor or an existing one, make sure the interior environment is at “normal living conditions.” In other words, the temperature and RH should be what are normally experienced.

**NOTE:** Check the MC of the wood floor before sanding to ensure that it is within the normal range for that environment. Record the MC. That MC can be used for comparison later when checking MC between coats of water-based finish.

To Learn More, Visit www.wagnermeters.com
Subflooring

Healthy flooring is built upon a healthy subfloor installation.

When installing hardwood floors, builders often cover wood joists with wood subfloors. At other times, installers lay engineered wood over concrete subfloors. Add to this the rapid evolution of eco-friendly adhesives, and you get a sense of the complexity in installing modern flooring.

Today’s flooring choices are so varied that subfloor moisture issues can have a large impact on the success of the flooring installation.

MC is the proportion of moisture held in a material, and applies to both wood and concrete. Every wood cell contains moisture, while every concrete slab contains some amount of water. By installing wood floors over concrete slabs with adhesives, we add moisture between the floor and subfloor. Flooring adhesive manufacturers are replacing toxic VOCs with water. Between the concrete, the wood and the flooring adhesives, it is impossible to avoid the need for proper MC measurement and management.

Industry rule-of-thumb: make sure the subfloor is clean, dry and flat before applying any flooring. To ensure the subfloor is dry enough for installation requires moisture testing.

Following are some general guidelines as they relate to specific combinations of building materials in floors and subfloors.

**Plywood and Oriented Strand Board (OSB) Subfloors**

Newer homes with basements and crawlspaces utilize plywood and OSB subfloors over joists. The greater the space between joists, the thicker the plywood and OSB must be. Fasteners must be properly placed (according to manufacturer’s specifications) so they do not protrude.

Subfloors must be free of contaminants such as paint, sealer, or drywall compounds. This wood based flooring combination must be flat for successful floor covering. The subfloor can be flattened by sanding down the high areas or by installing shims. If there are any creaks, squeaks, or loose panels, refasten the subfloor to the joists before applying the flooring.

A wood moisture meter can be an extremely helpful tool to preempt warped wood subfloors. The National Wood Flooring Association (NWFA) recommends that flooring installers measure the MC of the subfloor and the joists first. In fact, the NWFA recommends a minimum of 20 moisture meter readings for every 1,000 square feet. Using moisture meters is vitally important to guaranteeing the integrity of the wood subfloor.

**Particle Board over Plywood Subfloors**

Installers frequently find particleboard as a subfloor layer over plywood when carpeting or vinyl is ripped out. Since particleboard has no holding power for fasteners, the only suitable wood flooring that can be installed is a floating floor. Other wood floors can be installed if the particleboard is ripped out.

Particleboard is manufactured by mixing wood particles or flakes with a resin and forming the mix into a sheet. In panel production, other chemicals including wax, dyes, wetting agents, and release agents can be added to make the final product fire and insect-resistant or to give it some other special quality.

The sheets are cold pressed to reduce their thickness and to make them easier to ship. Particleboard is very prone to expansion due to moisture, especially if not covered with a paint or sealer.

Ironically, plywood’s construction can also pose a MC challenge. Plywood consists of several thin sheets of veneer, which are first dried and then glued together. The veneer sheets are applied with an adhesive and stacked. The glued sheets are then usually run through a hot press to dry the glue and are then trimmed, sanded if necessary, and then graded for quality.

Wood flooring lovers need not fear this, but they certainly must utilize moisture meters to ensure stable MC in these types of materials. Improper MC levels in the subfloor can produce all kinds of residual flooring problems when covered by wood, carpet, or vinyl. Thus, moisture meter testing is even more imperative with wood subfloors made from multi-sourced wood products.

**Concrete Subfloors**

MC is part of a dynamic concrete slab formation process. There is always water content in concrete mixtures, and those mixes are becoming more engineered than ever. Homes without basements may still have concrete subfloor foundations below the ground (known as “grade”).

A concrete moisture test is equally crucial to concrete subfloors. The water content in concrete migrates from the bottom of a slab to the surface, where it evaporates according to changes in ambient RH. The internal moisture must be allowed to dry appropriately, based on the flooring and adhesive being used on the job. The internal moisture is key because once the finished floor product is installed, the moisture equilibrates and the moisture at the surface of the concrete slab will eventually rise. If the internal moisture is not appropriately dry, it may cause problems with the adhesives and flooring products.

Many builders mistakenly believe that surface MC levels reflect those of the whole slab. It is essential to verify internal slab moisture levels. A concrete moisture meter works for surface-level MC assessment only, but to see further into the slab, RH testing is required. Surface moisture testing of concrete slabs can be very misleading and can lead to flooring failures.

A successful flooring installation is done on a dry, clean, and flat subfloor. Period. Keep moisture testing and assessment at the top of your list.
GUIDE TO VOID WOOD FLOORING FAILURES

Wood Moisture and Why You Need Water Popping

A wood flooring manufacturer buys kiln-dried lumber and cuts it down to size. Then, the lumber must be sanded down – often through several passes. During this process, the hardwood goes from being coarse to becoming fine and extremely smooth.

The sanding process closes the natural grain of the wood so the wood is no longer porous enough to accept stain. That’s because the tiny wood particles and sawdust get stuck inside some of the pores.

The sanding process begins with a coarse, low grit paper to flatten and clean the wood, then progressively finer grit sandpaper is applied to smooth the surface even more. Finer grits tighten the grain fibers, making the wood denser and less porous and penetrable.

The result is that the stain is not absorbed deeply into the wood, and most of the stain will be removed when wiped with a cloth.

Benefits of Water Popping

Water popping, also sometimes called grain popping, is a process used to re-open the pores in the grain of the wood flooring so it will accept stain more readily and evenly. In other words, it makes hardwood floors porous again so that hardwood flooring can be properly stained and finished.

This process has many benefits:
- It allows the stain to be applied more evenly across the floor.
- It raises the wood fibers so the stain goes deep in the wood for a nice finish.
- It helps create a professional look and feel without any sanding marks.
- It makes the color stand out.

According to National Wood Flooring Association (NWFA), it’s important to use a precise quantity of water. Too much water can over saturate the wood. This can cause the wood to swell in the short term. In the long term – as humidity decreases – the wood will release the excess moisture.

NWFA, therefore, offers these basic guidelines when attempting water popping:
- Before attempting to use the water popping technique on a floor, do a test on a sample board. The key to successful water popping is controlling the amount of water applied to the wood and the amount of time the wood needs to dry before applying the stain.
- Measure the MC before water popping to establish the baseline MC, and then test to see how long it takes for the wood to return to its original MC.
- Be aware that the effect of water popping will vary. It depends on the amount of water used, the length of time it’s allowed to dry, the species of wood, and the type and color of stain to be applied.
- Record the MC of the wood flooring before water popping. The wood must be allowed to dry completely and the flooring must return to the correct MC before proceeding with the finish application.

Additional Guidelines

Refined Hardwood Flooring in Wilmington, N.C., a full-service hardwood flooring contracting company and long-standing member of the NWFA, offers additional guidelines:

To reduce this risk and to help distribute the water evenly, many flooring professionals use a T-bar. It’s basically like a window squeegee with a long handle. For smaller jobs, or for tough-to-reach areas such as inside corners, use a hand-held squeegee.

Some use chemical sprayers to mist the floor with water. Some use a buffer with a soaked carpet pad. Still, others run a wet mop over the floor. Perhaps the most effective way, though time-consuming, is with a bucket, a rag, and getting down on your hands and knees.

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No matter which method, it is fairly easy to do. This is especially true if you have experience with applying water-based finishes. The difference is that water popping employs clean water without chemicals, whereas finishes often contain substances that can hurt the wood.

It’s best to use purified or sterile water, not tap water. Tap water can contain excess chlorine and other chemicals that can react with the wood or the stain.

A standard plant watering can may be used. Pour a 2-inch line of water, with the direction of the flooring grain. Then use the T-bar to even out the water.

After coating the whole floor, no matter which method you choose, let it stand and dry on its own for between two to four hours. At that point, the floor should be somewhat gritty, with it no longer having a smooth touch to it. This is the effect of the grain in the wood reopening.

Perhaps the most important step in the process is the close examination of the whole floor. You need to make sure the surface of the floor feels the same throughout. An area that is rougher or smoother than other areas may indicate that you did not apply the water uniformly.

After this process, if the surface of the floor is consistent, then the process was successful and stain can be applied.

However, if the floor surface feels different in spots, then it is necessary to repeat the process, or more likely re-sand the floor. Remember, if re-sanding is required, the water popping process is necessary afterward.

A DEEPER LOOK AT THE BENEFITS

Stain More Evenly across the Floor
Due to the application of various grits when sanding, the grain throughout the floor may not be uniform. When water popping is done correctly, the pores are opened throughout the flooring, allowing the stain to be more evenly applied.

Raises Wood Fibers Promoting Stain Penetration
Water popping causes the fiber in the wood to stand up, providing greater surface area for the stain to absorb and penetrate deep into the wood. Applying two coats of stain can give you an even nicer look.

Sustain a Professional Look and Feel without Any Sanding Marks
Even the best professionals can make a mistake. Sanding wood flooring can leave marks, however small, that are noticeable until after the wood is stained. When the grain is raised from water popping, any sanding marks blend in with the wood fibers, and when stained the marks won’t stand out.

The Stain Appears Darker and Richer
Perhaps the thing that stands out the most on a wood floor is the deep rich color. Water popping enables you to make your stain appear darker and richer. Darker and richer floors are noticeable, which many people admire. Be sure to ask to see the color you select on a sample of water-popped wood. Otherwise, the color you are shown may not be what ends up on your floor.

RISKS

Uneven Water
If you pour uneven amounts of water on different sections of the floor, you increase your risk of the wood absorbing various quantities of moisture. This can cause your floors to break down in the near or distant future, and your stain will look blotchy afterward.

Staining before the Floor Is Dry
If you do not allow enough time for the floor to dry before staining the wood, you run the risk of the stain appearing blotchy. Drying time can differ by temperature, humidity, and air circulation in the room. The lower the temperature, higher the humidity, or less air circulating, the greater amount of time you need for drying.

Sensitivity to Scuff Marks
Once the wood has absorbed water, it becomes soft and more susceptible to scuff marks. For this reason, you should not walk on the floor with any type of hard shoe or boot between the time of water popping and completing the staining process. Instead, wear only socks or slippers with very soft bottoms.

The Outcome Varies by Wood Type
The outcome from water popping can be incredible. You can have a professional floor that will last for a lifetime. Visitors will commend you for a good job.

Nonetheless, your outcome can differ not only by the actual process, but also by the type of wood. Each type of wood can differ in the amount of water needed for popping and the length of time to dry. Different types of wood also vary in how the color of the stain appears. These are the reasons why you ought to sample a piece of wood to “water pop” before committing to buying and installing the whole floor.

What You Need Now – Moisture Measurement
Anyone can do it, but not everyone will do it right. This is a job best left to the professional wood flooring installer so as to avoid risks and maximize the benefits of water popping.

By looking at MC at various places throughout the floor, you can get an accurate glimpse of how the moisture levels in the environment – now and later on – will affect the wood.

When the wood contains a low level of moisture that’s at equilibrium with the environment and uniform throughout the floor, you can then seal it and apply the stain. An accurate wood moisture meter can help you lower or prevent the risks from improper water popping.

To Learn More, Visit www.wagnermeters.com
Conclusion

A well-performing wood floor is often the result of an installer taking the proper time and care necessary for a successful installation. It involves knowledge of the expected MC of wood flooring in a particular area after acclimation . . . the MC of flooring at the time of installation . . . and the expected “in use” changes.

It’s also important that professional installers educate their customers about proper maintenance procedures and normal expectations for their wood flooring as part of the installation process. The owner needs to know how wood reacts to changing temperature and humidity conditions, and what constitutes acceptable gaps between boards that will disappear as the seasons change.